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ON THE

PREVENTION

OF

ACCIDENTS IN MINES.

BY

JOSHUA RICHARDSON, F.G.S.—M. INST. C. E.

AUTHOR OF THE PAPER ON THE VENTILATION OF MINES,
FOR WHICH THE TELFORD MEDAL AND THE COUNCIL'S PREMIUM WERE
AWARDED BY THE INSTITUTION OF CIVIL ENGINEERS, &c.

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PREFACE.

The great number of violent deaths which are constantly occurring among persons engaged in the collieries, iron, copper, and lead mines of the United Kingdom, urgently requires such preventive and remedial measures as will tend to the diminution of the loss of life and much bodily suffering. That these evils do exist to an extent that may appear incredible to persons unacquainted with the subject, and that it is practicable very considerably to lessen them, is very generally admitted by those who are, or have been engaged in directing mining operations, and have given serious attention to the subject. There is however a great diversity of opinion as to the best means to effect this object, and there is a strong repugnance prevalent among the proprietors and directors of mines to all Government interference with the management. The force of public opinion, it is alleged, is quite sufficient to induce the owners of mines to adopt those improvements which are imperatively required. Experience, however, has proved that such a remedy, in a great many instances, is quite inoperative, and that something more compulsive is necessary to induce the universal adoption of the requisite means of safety.

It has also been stated that legislation on the management of mines is impracticable, and would be highly injurious to the interests of the proprietors. A perusal of the following pages, it is presumed, will convince the impartial reader of the futility of these objections, and that the interests of all parties would be most served by judicious legislative enactments.

It is well know that in France and Belgium mining operations are conducted under the supervision of Government Officers who are empowered by law to compel the strict observance of all the requisite means for the prevention of accidents; and that the loss of life in the mines of those countries, has, in consequence, been very considerably diminished. But it has been said by the opponents of Government interference,—"When the example of foreign countries was quoted, it should be at the same time shown in how backward a state they were in engineering, in mining, in commerce, and in fact in every thing with which the Government interfered, as compared to the high state of perfection arrived at in this country." And it is added "in short, to do any good, Government must leave the matter alone."* It is by no means certain, nor have there been any facts adduced to prove, that the less advanced state of mining in Belgium and France is to be attributed to these laws, on the contrary, reasons for it may be found in several other and more probable causes; whilst it is indisputable that our prosperity is not owing to the absence of wholesome sanitary laws, nor can it be propitiated by the annual sacrifice of the lives of upwards of two thousand of our fellow countrymen. The Government has "left the matter alone" for six centuries, and by such a policy has fostered an accumulative evil as destructive in its consequences, as it is derogatory to our national character. It is, however, satisfactory to know, on undoubted authority, that Her Majesty's Ministers intend shortly to direct the attention of Parliament to this important subject; and as it is probable that any measures which may be proposed for this object, will have to encounter a strong and persevering opposition, it is obviously expedient that information on the subject should be diffused so that the public generally may be enabled to appreciate the merits of the proposed measures and be prepared to give the Government such support, by petitioning Parliament and otherwise, as the interests of humanity may require.

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* The Morning Post, 25th March, 1817.

In the absence of other and abler works on this subject, it is hoped that the following pages will, in some degree, serve such a purpose.

Information respecting the most improved systems of ventilation, and the means used for the prevention of accidents, is much needed in some mining districts; and it is anticipated that this attempt to diffuse practical knowledge on this interesting subject may be of some service to miners generally, but especially to those to whose intelligence and care the safety of many lives and much valuable property is entrusted. To render the system of ventilation described in pages 32 to 36, more easily understood, two plans with an explanatory reference, shewing the methods pursued in the North of England and in South Wales have been added and will be found at the end of this volume.

It is not without considerable diffidence that this treatise on a subject affecting the rights and property of a large and influential class, is submitted to the public. The author relies for his apology, if any be needed, on his firm conviction of the absolute necessity there is for the measures he recommends.

Since this work was written, a lamentable explosion occurred in a colliery in this neighbourhood by which twenty men were killed. This happened on the 29th of March last.* The sympathy of the public was strongly excited by this calamitous event, and great exertions were made to relieve the widows and orphans of the unfortunate sufferers. Among those who were most active in this work of benevolence were the Rector and Churchwardens of Neath, and the County Magistrates of the district. The deep interest manifested in the subject at the inquest, by the former gentleman, induced the author to submit this work to him, by whom it was shown to the Magistrates. The unanimous opinion of these gentlemen was in favour of its immediate publication; and, in consequence of their desire, the manuscript was placed at the disposal of the Rev. H. H. Knight, B. D., under whose auspices it now appears before the public.

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*NOTE. - Another explosion has occurred in the County of Cumberland since the following pages were printed, thus adding a fresh fact to those already accumulated and proving the urgent necessity there is for immediate legislative interference. In the Sunderland Herald of the 3rd. Inst. it is described as follows:—On Saturday an accident, by which nearly thirty persons were deprived of life, was occasioned by an explosion of fire-damp, at a pit on Wynie Hill, Cleaton Moor, near Whitehaven. More than twenty bodies were brought up the shaft in a dreadfully mangled condition, and ten more were undiscovered, of whose existence in the pit in the morning there is the clearest evidence—namely, the statement of the only survivor, who managed to ascend the shaft, leaving below several others ready to follow him, but whom the after-damp suffocated instantaneously. The bodies having been identified for the purpose of a coroner's inquest, were removed in carts from the spot, which presented a frightful spectacle from the dead placed around, scorched and dis-

NEATH, SOUTH WALES,

December 4th, 1848.

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figured—the piteous cries of the wives, children, and friends of the deceased, as the blackened remains of each were brought up from the pit—the utter appearance of desolation which the works themselves exhibited, and the continued fall of heavy rain and hail. The cause of the catastrophe is attributable to bad ventilation.

In a Newspaper of a subsequent date we are informed that "gaseous explosions are by no means uncommon in this extensive mining district, that 30 lives were lost, that 17 of the sufferers were married and have each left a widow, and in the whole 52 children. The evidence given at the inquest proved that the colliery was in a very dangerous state and that the accident took place in consequence of some of the workmen having taken off the top of the Davy-lamps to light their pipes, and thus fired the inflammable air in the pit. Verdicts in the several inquests were taken differently, but in all they amounted to the ordinary form of accidental death."

ON THE PREVENTION

OF

ACCIDENTS IN MINES.

There are few men who are so much exposed to bodily injuries and violent deaths as the Colliers and Miners of the United Kingdom. In other dangerous employments, the Legislature has enforced the adoption of all available means for the prevention of accidents, and a strict observance of such measures as have been deemed requisite to ensure the safety and promote the health of the workmen. The courageous and industrious body of men whose daily occupations are in the bowels of the earth, in the midst of darkness and many dangers, and who are secluded from the observation of all disinterested parties, have not received from the Legislature any measures of a protective or remedial nature at all commensurate with their necessities.

On the occurrence of any great calamity in our Collieries, such as an explosion, or an inundation, by which numerous lives have been lost, the attention of the public and of Parliament has been drawn to the subject, and, for a time, great interest has been manifested in it. On the subsidence of the excitement the subject has been lost sight of, until another accident happens, equally destructive to human life, and again attracts the public attention. In the fitful efforts which have been made to devise remedies for these great and constantly recurring evils, some valuable information has been collected by Parliamentary and other committees which were appointed for the purpose of instituting enquiries into the subject, yet, with the exceptions of the invention of the safety-lamp, and the law prohibiting boys under ten years of age and females from being employed in mines, I am not aware that any other practical good has resulted from them.

As a class the miners are particularly entitled to every amount of protection that can be given to them by the Legislature. Coal, the principal produce of their labour, is essential to our national existence, for without a plentiful supply of good fuel, the steam engine would become comparatively useless, and our manufactures and commerce paralysed. The safety of the pitmen is important too as an economical consideration, as well as on the score of humanity. On the security of the capital invested in mines, the price of the coal to the consumer in a great measure depends. Scarcely an accident can happen in a colliery that inflicts death on the miner, but what imposes at the same time additional expense on the proprietor. To cover the loss thus incurred, he is obliged to demand a higher price for his coal than he would do, were the risks less. The interests of all parties, therefore, are promoted by the avoidance of accidents, and the adoption or enforcement of any measures which would effect this, would be beneficial, not only to the proprietors and workmen. but to the consumers also.

It is a lamentable fact that all the resources of practical science are insufficient to prevent explosions and other mining accidents in all cases, yet it is equally certain that the number of these calamities would be very considerably diminished were the known means of prevention universally and invariably resorted to. The life of the adventurous miner being ever in danger, even when every known means of precaution are taken to avoid or prevent it, he is surely entitled to an exemption from needless risks. Yet, experience has proved that, whilst some of these accidents have arisen from the carelessness and fool-hardiness of the men, a much greater number have been occasioned by the negligence, ignorance and niggardliness of the managers and proprietors.

In 1841 a Royal Commission was appointed "for inquiring into the employment and condition of children in mines and manufactories." The Reports of the Commissioners and Subcommissioners, with the evidence collected in the several mining districts, were subsequently published, and constitute a mass of valuable information regarding the state of the mines, and the condition of the persons employed in them. In perusing the following pages, it will be observed that great use has been made of these important documents; which scarcely requires an apology, yet some explanation may be thought necessary. I might have stated concurrent facts derived from my own professional experience, and from the testimony of persons engaged in mining, with whom I am acquainted, but it appears to me that the course I have pursued will be least liable to objection. Where it is borne in mind that this evidence was obtained in the several localities of most, if not all, the mining districts of Great Britain, and the reports of the sub-commissioners were made on a personal inspection of many of the collieries, and that too by able and perfectly disinterested parties; it is apparent that the value of such testimony is unimpeachable, and much more satisfactory than any other which could be adduced.

In concluding their first report the Commissioners say:—

"From the whole of the evidence which has been collected, and of which we have thus endeavoured to give a digest, we find:—"That in many instances much that skill and capital can effect to render the place of work unoppressive, healthy and safe is done, often with complete success, as far as regards the healthfulness and comfort of the mines; but that to render them perfectly safe does not appear to be practicable by any means yet known; while in great numbers of instances their condition in regard both to ventilation and drainage is lamentably defective.

"That in all coal-fields accidents of a fearful nature are extremely frequent; and that the returns made to our queries, as well as the registry tables, prove of the workpeople who perish by such accidents, the proportion of children and young persons sometimes equals and rarely falls much below that of adults.

"That one of the most frequent causes of accidents in these mines is the want of superintendance by overlookers, or otherwise to see to the security of the machinery for letting down and bringing up the work-people, the restriction of the number of persons that descend and ascend at a time, the state of the mine as to the quantity of the noxious gas in it, the efficiency of the ventilation, the exactness with which the air-door keepers perform their duty, the places into which it is safe or unsafe to go with a naked lighted candle, and the security of the proppings to uphold the roof, &c.

"That there are many mines in which the most ordinary precautions to guard against accidents are neglected, and in which no money appears to be expended with a view to secure the safety, much less the comfort of the work-people.

"That, partly by the severity of the labour and the long hours of work, and partly through the unhealthy state of the place of work, this employment, as at present carried on in all the districts, deteriorates the physical constitution, &c.

"That, by the same causes, the seeds of painful and mortal diseases are very often sown in childhood and youth; these, slowly but steadily developing themselves, assume a formidable character between the ages of thirty and forty; and each generation of this class of the population is commonly extinct soon after fifty.

"When we consider the extent of this branch of industry, the vast amount of capital embarked in it, and the intimate connexion in which it stands with almost all the other great branches of trade and manufacture, as a main source of our national wealth and greatness, it is satisfactory to have established by indubitable evidence, the following conclusion:—

"That the coal mine, when perfectly ventilated and drained, and when both the main and the side passages are of tolerable height, is not only not unhealthy, but, the temperature being moderate and very uniform, it is, considered as a place of work, more salubrious and even agreeable than that in which many kinds of labour are carried on above ground."*

The voluminous evidence fully bears out the conclusions of the Commissioners, and most unequivocally proves, that in many collieries the most culpable neglect is shewn in not providing for the safety and health of the miners; whilst in those pits in which the most approved system of ventilation, and other known precautionary measures are pursued, fatal accidents are much less frequent, and the general health of the workmen is much improved.

It is very difficult to form any correct estimate of the number of lives that are annually lost by mining accidents, as with a few exceptions no record or register of them has been kept. The sub-Commissioners state that the Registrars of many of the colliery districts have performed their duty in a very defective manner, and little or no definite information can be obtained from their returns. It appears that during a period of forty years, fifteen hundred lives have been lost by explosions in the collieries of Northumberland and Durham. These accidents were so destructive to life and property as strongly to attract public attention, and the details concerning them have been extracted from the newspapers of the day. There are fatal accidents constantly occurring of which no notice whatever is taken in the newspapers, and of which no record of any description is kept.

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* First Report, p. p. 255 to 258.

In an able article "on the accidents in mines" which appeared in *Chambers' Edinburgh Journal*, the writer says—"There is now before us a list of accidents gleaned from the pages of the *Mining Journal*, for a period of eight months, by which it appears three hundred and one individuals have lost their lives, and one hundred and eighty-two received severe and permanent injuries. According to a parliamentary report, the annual loss of life in the Bromwich, Tipton, Dudley and Wolverhamton district amounts to one hundred and ten; and it is stated by the Midland Mining Commission, that out of eleven hundred and twenty-two deaths of colliers, not fewer than six hundred and ten arose from accidents. All this points to a fearful amount of individual suffering, as well as national loss; and yet we believe nine-tenths of these calamities are never known beyond the locality in which they occur. In fact, according to the best authority, scarcely a fifth of the accidents which happen in connexion with mining operations is recorded in the newspapers, and proceeding upon this estimate, they calculate that two thousand five hundred lives are annually lost to Britain through this cause alone." *

In the reports of the sub-Commissioners, it is stated that—

In South Staffordshire "The mining accidents are numerous, and to judge from the conversation which one constantly hears, we might consider the whole population as engaged in a campaign."

In Shropshire "Accidents are very numerous. Mr. Webb, of Bankhouse, states that he has had as many as five hundred cases from accidents in one year. Another surgeon estimates the accidents from explosions brought for relief to the Union Surgeons as being about one hundred in a year."

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* New Series, Vol. 1, p. 206.

In South Durham—"It is to be feared that accidents are frequent, and although it must be admitted that the nature of the work is such, that numerous accidents must always be unavoidable, yet the impression which is irresistibly formed in the mind is, that the accidents might be considerably diminished."

In Yorkshire.—"Accidents of various sorts and degrees are so frequent in collieries, that it is impossible to give anything like a correct statement of all that have happened in each colliery for three years, or even for a much shorter time. Numbers never reach the ears of the employers at all, and of those that are known to the underground steward, unless they are very serious, he keeps no record."

In Cumberland. "The accidents in the Whitehaven and Workington collieries, were, until within the last eighteen months, most numerous and fearfully fatal. They have arisen chiefly from fire-damp and irruptions of the sea."

In the West of Scotland.—"From the recollections of surgeons, work-people and managers, I gathered that serious accidents, even fatal ones, are by no means rare, and lesser ones of constant occurrence in coal and iron pits."

In the East of Scotland.—"In the absence of all satisfactory returns on this head, we have the authority of a medical gentleman well acquainted with the colliery districts, that a week seldom passes without some serious accident occurring in one or more of the collieries, and several persons are killed, or die in consequence of accidents every year."

In Northumberland.—"Notwithstanding the systematic and scientific knowledge of mining matters which characterise the district, it may perhaps be not futile to inquire whether many of the fifteen hundred lives which the tables I have compiled show to have been sacrificed in little more than forty years, might not have been saved by the adoption of more extensive and more stringent precautionary measures. The propriety of such an inquiry will perhaps become still more apparent if we concentrate our attention for a moment on the number of lives lost within the last two years, by what may be distinguished as ordinary casualties in coal mines. A reference to the tables will enable us to approximate to the minimum of such casualties in a given number of collieries; while it will be observed that those terminating short of death are lamentably numerous. From these tables it appears that in nine collieries, three hundred and fifty men and boys suffered bodily injury in one year, that twenty-four were killed by an explosion, and that the whole number of persons employed in forty-six collieries was twelve thousand two hundred and thirty-five. The number of such casualties (employing the term in contradistinction to accidents caused by explosions, inundations, &c.) would, I imagine, be found, upon a production of similar records, to be very considerable." "I think" said Mr. Buddle, "there is scarcely a week passes without a life being lost in some of the collieries. I should say the casualties are more than those lost by explosion, on the whole."

In the Forest of Dean.—"Fractures, dislocations, and contusions, are casualties apparently inseparable from mine work. It is true that precaution could not always avert accidents; but I have no doubt, from my own observation, as well as from the testimony of numerous managers and overlookers, that at least three-fourths of the injuries sustained in collieries might be avoided by the exercise of common prudence."

In North Somersetshire.—"The chapter of accidents is with them unhappily a very ample one; but here too, it appears that greater attention and foresight may be insisted upon; and there is no doubt that these would be sufficient to protect the work-people from many injuries which are now of frequent occurrence. In some mines where fire-damp prevails, the colliers' health gets soon broken from the deleterious quality of the air."

In the West Riding of Yorkshire.—"By the Coroner's return, it appears that within three years and six months fifty fatal accidents have happened. On the perusal of the verdicts it will be seen that, in a large proportion of these cases, the fatal results might have been avoided by precaution and care on the part of the proprietors and of the colliers themselves; nor has this neglect subjected the parties guilty of it in any case to that reprehension and punishment which it appears to me might be employed with effect in diminishing their frequency. It did not much surprise me to be told that old age came prematurely upon them, and that they were "mashed up" at forty or forty-five: indeed the care-worn countenances, the grey hair and furrowed brows of those I met with at that age were sufficient indications of the fact, and the only wonder is that human life should be even so far prolonged in an atmosphere constantly impregnated with noxious gases, that are ever heard escaping with loud crackings from every newly made surface; together with the exhausting influence of excessive perspiration, occasioned by the severity of eight, ten, or twelve hours continuous labour, in order to support their own cheerless existence and that of their families. The ventilation of the mines in the neighbourhood of Halifax is extremely imperfect."

In Lancashire.—" Accidents of a more or less serious character are of daily occurrence in almost every mine where a large number of persons are employed; so common indeed, that a record is seldom kept."

In Derbyshire.—" There is no life more subject to accidents than that of a collier, and in the words of William Wardle, " he always reckons it a life of great danger both for man and child; they are subject to both broken limbs, wild-fire," (by which they are killed or burnt) and black damp" (which suffocates them) "and he may say a collier is never safe after he is swung off to be let down the shaft."

Near Oldham.—" Mr. Joseph Wild, chief constable of Oldham, says:—" The neighbourhood of Oldham is the most fruitful to the Coroner of this part of the County, because of the number of the population and the nature of their employment in mines and factories. There have been a deal of accidents to children and young people, as well as to the men, in the mines here, during the last five or six years. Many accidents have occurred from fire-damp. There are scores of cases in which individuals are badly burned, who do not die, but are made cripples for life. There are so many killed that it becomes quite customary to expect such things."

More extracts might be added of a similar purport, but those already cited will perhaps be deemed sufficient to prove, the existence of a "fearful amount of human suffering," and that the estimate already given of the annual loss of life among our mining population is, most probably, by no means exaggerated.

Nor are the killed the only sufferers. Unfortunately there is a much more numerous class of human beings who, from similar causes, are reduced to comparative helplessness by burns, fractures, contusions and other bodily injuries received in the mines; and there are many others who are pining away under the sufferings of irremediable disease contracted in the poisonous atmosphere which they were obliged to respire in the pit.

The maintenance of disabled colliers and their families constitutes a very considerable item in the expenditure of the poor rates in mining districts; and I have no doubt, but that the saving which would result from legislative enactments, compelling the adoption of protective measures, would much more than compensate the country for the requisite expenditure in carrying these measures into effect. Where no record is kept of fatal accidents, we need not be surprised that less important casualties are not registered: in three instances however a record has been kept, and from this we learn that in the same period eighty-two were killed and four hundred and sixty-one seriously lamed or injured. But those who are disabled by diseases contracted in the mine are not included in this number. Taking it however as it is, it makes the wounded 5⅝ times the number of the killed, Supposing that we take it at five times only, and that the killed amount to two thousand five hundred per annum,* it gives us twelve thousand five hundred persons who are either temporarily or permanently thrown upon their respective parishes for the subsistence of themselves and families!

I do not expect that implicit credence will be given to these estimates, but in the dearth of true data, I have ventured rather to suggest them as within the bounds of probability than to state them as facts, and leave others to make their own inferences. Without reference to any numerical estimate however, there can be no doubt whatever, but that a vast amount of suffering is endured by a valuable and industrious class of our fellow-countrymen, without any efficient practical efforts having been made by the legislature to ameliorate their condition.

That the number of these accidents might be very considerably diminished, and in many cases altogether avoided by the adoption of known protective and precautionary means, I have not the slightest doubt. This opinion is derived from my experience in the management and working of collieries, and is confirmed by the reports and evidence already quoted.

In the Shropshire district, the sub-Commissioner, after stating the number of accidents which have happened there, continues:—"This is a very lamentable state of things, and might be most easily obviated by a better ventilation. It is not sufficient that the men should be able to breath somehow, they ought to breath pure air, and the ventilation should be such as to remove all danger from noxious gases, and in this district it might easily be done."

In Yorkshire, the sub-Commissioner observes: "That neither drainage nor ventilation are sufficiently attended to for the health and comfort of the work-people in a majority of cases; whilst in some the ventilation is so imperfect that it is positively dangerous. The general opinion of those competent to judge is, that where mines are thoroughly ventilated, they are by no means unhealthy. I cannot conclude this branch of the subject, without expressing in the strongest manner, my conviction of the gross negligence of the means of safety prevailing in many collieries. So far from precaution being proportioned to the amount of peril, although the danger is tenfold greater, there is often less care taken to guard against it in collieries, than in any description of factory I have ever seen. If ever there was a case imperatively requiring legislative interference, it is the neglected safety of colliers."

South Wales, the sub-Commissioner reports:—"In the course of my enquiry a few remaining points attracted my observation, the results of which I will endeavour to lay before you as briefly as possible. The most prominent of these is the subject of ventilation in the workings of a particular vein of coal, extending from Penwhyn Frank to Llanvabon Church; and to this subject my attention was more particularly drawn by the fact, elicited in the course of examination in that district, of the frequent stoppages of the works in consequence of choke-damp; and as the subject is of peculiar interest in the economy of mines, and the health of the miners, I subjoin the following communication on the subject:—"The principal seam at present in work for the supply of the export trade of Newport is a redashed coal in which fire-damp is not found. The absence of fire-damp in this vein has operated very prejudicially throughout the district, by creating a confidence in the minds of the parties engaged, that whatever the state of the ventilation may be, no explosion of fire-damp can possibly occur; consequently the ventilation of the collieries is much neglected. It is a common occurrence for colliers to be obliged to leave their work, from not being able to keep their lights in, and in some cases, when the wind is at an opposite point to the level, the ventilation is so bad as to stop the work; the colliers work as long as they can keep a light in, but the small quantity of air necessary barely to maintain combustion must be a very unhealthy atmosphere for respiration."

In the Durham, Northumberland and Cumberland Lead Mines, we are informed that:—"The place of work in the mines is injurious to the health of miners, even where there is not just complaint of the want of ventilation. That the air is often very bad, is proved by the evidence of practical miners. Mr. Jacob Crawhall says:—"Sometimes there is foul air sets into the mine; sometimes when we are driving far from the air course, and are obliged to do it, the air comes in which puts the candle out, and we are obliged to leave. Not many are suffocated by it; only very few. Sometimes we must hang the candle half perpendicular, that the grease may flow down to the flame of the candle, and burn in spite of the foul air. We never have any air which explodes; we have only the heavy foul air, the damp. When the foul air is breathed it breaks a person's wind. It is very seldom that men stop in so long as to fall down, and need to be carried out."

These extracts point out conclusively the causes of many, if not of most of the accidents which occur in mines. The importance of the subject is increased from the circumstance, that the state of the ventilation of a mine is generally indicative of the good or bad management with which the whole works are conducted; for we find where the ventilation is imperfect, the other means of safety are also neglected, and as a direct consequence, the accidents are most numerous, even in mines wherein fire or choke-damp does not exist to a dangerous extent. In the twenty-four mining districts mentioned by the Commissioners, it appears that—six are well ventilated and have few accidents; four are well ventilated and have many accidents; and fourteen are imperfectly ventilated and have numerous accidents.

Thus in twenty-four districts, the mines in fourteen of them are imperfectly ventilated; and when it is considered that such a state is the most fruitful source of diseases and violent deaths, we cannot surely have a stronger argument to prove the necessity there is for legislative interference. For it must be borne in mind that this is a remediable evil, as is proved by there being ten districts out of the twenty-four in which the ventilation is generally good. We are therefore obliged to conclude, that the lives of the workpeople are unnecessarily exposed to danger from motives of ill-judged economy, or from the most culpable negligence of the proprietors, and that it is neither prudent nor just to permit the continuance of a discretionary power involving such serious results, without some wholesome regulations, so as to increase the responsibility of its exercise, and limit the extent of its operations.

The only practical result of the inquiries instituted by "the Children's Employment Commission" was the passing an Act of Parliament which prohibited the employment of boys under ten years of age and females in mines; and although the opinions of the Commissioners, as well as the evidence which they collected, plainly intimated the necessity there was for more comprehensive measures, nothing has yet been done. It was anticipated by many persons interested in the subject, that the publication of these reports would induce such an improvement in the management of mines, as to supersede the necessity of legislative interference. Five years have now elapsed and the improvement is still prospective only! Indeed, owing to increased consumption of coal and iron, the partial or total exhaustion of old mines, and the opening of new ones in districts in which the least improved and worst system of working and management most prevails, the number of accidents have been rather increased than diminished, during this period; and the necessity for Parliamentary interference is equally, if not more imperatively required now than it was in the year 1842.

There is a very prevalent notion that an efficient legislative interference is impracticable, in as much as the working and management of collieries is a subject too complicated in its details, and varied in its circumstances, to permit the introduction of any remedial system of general application. However cogent and plausible this objection may appear to those who are unacquainted with mining operations, it cannot, I think, be sustained by any evidence derived from practical experience. On the contrary, an analyzation of the causes of accidents, and an examination into the practical detail of the sanatory regulations which are observed in the best managed collieries, will prove that there are no insurmountable physical difficulties to be overcome.

The accidents which occur in mines, may be classed under five different heads, viz:—

FIRST.

From explosions of "fire-damp" or carburetted hydrogen gas, and the prevalence of "choke-damp" or carbonic acid gas.

SECOND.

From coal or stones falling from the roof.

THIRD.

From men falling down, and coal or stones falling on them, whilst descending or ascending the shafts.

FOURTH.

From inundations from old works or other adjacent waters.

FIFTH.

From miscellaneous causes.

These I propose to discuss separately, so as to enable the reader fully to comprehend the nature and extent of the evils which exist, and by explaining the operation of the best preventive means now in use, attempt to prove that the extended application of them, even by compulsory enactments, is neither impracticable nor unreasonable.

EXPLOSIONS.

I.

Among the casualties of a mine, an explosion of fire-damp is the most destructive to human life. Whenever they happen in large collieries, few that are in it escape alive; fifty to one hundred men being instantly killed by a single general explosion. Whilst by those of a more partial character and which extends only to a small portion of the workings, but which are of more frequent occurrence, one or two men are killed, and others are severely burnt and disfigured.

These explosions are caused by the introduction of a lighted candle or other unprotected flame into an accumulated mass of carburetted hydrogen gas, and thereby causing it suddenly to ignite, which it does with an explosive effect like to that of gunpowder. This gas is constantly exuding from the coal, and is known among the miners as "fire-damp" and "wild-fire." It is lighter than atmospheric air, its specific gravity being little more than half of that of air. It will not explode unless it be mixed with six times its volume of atmospheric air, and its explosive power is destroyed when it is diluted with fourteen times its own volume of common air. In some mines the existence of this gas is unknown, in others it is very abundant, but in most it exists to a less or greater extent, those collieries in which it has never been observed being very few, may be considered as rare exceptions to its general prevalence.

There is another gas also fatal to animal life, which is found to exist in all mines. This is the carbonic acid gas, called by the miners "choke-damp" "after-damp" "black-damp" or "stythe." It is heavier than atmospheric air, its specific gravity being 1.5277, that of common air being 1. It also exudes from the strata, and is produced in large quantities on an explosion taking place, and is frequently more fatal in its effects than the fire-damp. In the explosion which took place in the Haswell Colliery about three years since, by which ninety-five persons were destroyed, fifteen only of this number were killed by fire-damp, whilst eighty were suffocated by the choke-damp. This gas will not support combustion and extinguishes any light introduced into it. "A single breath of it when pure is almost certain death."* Yet in some instances men are compelled to work in an atmostphere strongly charged with it as long as a candle will burn, however feebly, notwithstanding its highly deleterious nature. It frequently happens that in mines in which this gas only exists, or in addition to which there is only an inconsiderable quantity of hydrogen gas, the ventilation is the most neglected; and the inevitable consequence is, that although the number of sudden deaths may not be so great as in fiery mines, yet diseases which shorten life are contracted by the miners to a disastrous extent. Although less obtrusive to observation, the fatality is as great, if not greater than in fiery mines, owing to the very imperfect manner in which such mines are usually ventilated. The reason for this apathy to the health of the workmen may be, apparently ascribed to the fact, that the prevalence of this gas does not cause damage or destruction to the works; for however severe the implied censure may be, it appears by the evidence collected by the Commissioners, that in mines wherein fire-damp does not exist to a dangerous extent, great and culpable negligence is shewn as regards ventilation, whereas in those collieries most infested with fire-damp the ventilation is most perfect.

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* Dunn on the Coal trade, p. 96.

When either or both of these gases are produced, the obvious remedy is to dilute and displace them by forcing into the mine a constant current of pure air, so as to deprive them of their explosive and deleterious properties, and render the atmosphere of the mine fit for respiration. Upon the efficiency of the means used for this object the health and lives of the miners are dependent; I shall therefore devote a short space to a description of the most approved system of ventilation, which is both simple in its requisite arrangements, and effective in its operation.

To render this description more intelligible, I shall first give a brief sketch of the position of the coal in the earth and the mode of working or extracting it. Coal is found in several districts in England and in some places in Scotland and Ireland. The extent of the coal-fields in Great Britain is said to be 4,251 square miles, and the consumption is stated at twenty-three millions tons per annum. Coal is generally found in such a position in the earth as to indicate that it has been deposited in successive layers in large basins or troughs, and is found alternating with strata of sandstone, shale, ironstone, clay, &c. The seams or veins of coal are deepest from the surface in the middle of the basin, and rise towards and basset or crop out at the surface successively, the lowest seam cropping out at the farthest edge of the basin, and the highest rising to the surface nearest the centre. From this circumstance the seams are found to incline or "dip" towards the centre. In the Newcastle district the inclination is four to ten degrees; the thickness of the seams of coal varies from two inches to six feet; the distance from the highest to the lowest seam is nine hundred and twenty-eight feet, and the spaces intervening between them is from twelve to eighty feet.

In commencing a colliery it is always advantageous to sink the shaft or pit in the deepest part of the area out of which the coal is to be worked, so that the water may flow by its gravity from all other parts of the mine into the well or sump at the bottom of the shaft, and be thence pumped up to the surface. On the shaft being sunk into the coal, a drift or passage is driven at right angles with the dip, and from this drift and at right angles with it, another drift or passage is driven in the direction of "the rise," which is called a "headway;" and these "headways" are repeated every ten yards. In every length of thirty yards of headway another drift is driven at right angles, which is called "a borde" and which communicates with all the "headways." These "headways" and "bordes" are from eight to twelve feet wide, and from four to six feet in height; the coal is obtained by excavating these passages or galleries leaving intervening mass of coal called "pillars," which are thirty yards long and ten yards wide, to support the roof. After the whole or greatest part of the area has been thus worked, "the pillars" are either altogether or partially removed. This is the most dangerous work the miners have to perform, as sudden irruptions of large volumes of gas often take place during the operation, and unless the men are careful in substituting a sufficient quantity of timber props to support the roof whilst they are removing the pillar, the roof falls down on them and crushes them to death. When the pillars are all removed, or as many of them as is safely practicable, the roof is allowed to fall, and that part of the mine is abandoned, and is called "the goaf." (probably from the British word ogof, a cave.)

This plan of working the coal is pursued in the Counties of Northumberland and Durham, and partially in some other districts, but in the Midland Counties, where the roofs are stronger, it is worked in "the broad-way," that is a great breadth of coal is all excavated at once, without leaving any pillars; and in South Wales the plan pursued is, to drive a "level heading" at right angles with the "rise" and from this a "cross-heading" is driven in the direction of the "rise," on each side of this cross-heading and at nearly right angles with it "stalls" or chambers are excavated.

These three plans or modifications of them, are pursued in most of the coal-fields of England, and among experienced miners the Newcastle mode is generally preferred, as being the best adapted for obtaining the largest quantity of coal in the best condition out of a given area.

The collieries in the Newcastle district are well-known to be the most "fiery mines" in the kingdom, which renders a thorough ventilation indispensable, otherwise it would be impossible to work them; and this necessity has been met in an enlightened and liberal spirit by the coal owners of the district. The mode of ventilation pursued in this coal-field being the most perfect and efficient, I shall attempt a brief description of it. Each colliery has two shafts, about forty yards or more apart; one, through which the air descends into the mine, is called the "down-cast" shaft; and the other up which the air makes its exit from the mine, after having travelled through all the works, is called the "up-cast shaft." In some collieries one shaft is made to answer both purposes, by dividing it vertically into two or three compartments by an air-tight wooden partition or "brattice," one of which serves as a "down-cast" and another as an "up-cast" shaft, the third compartment being reserved for the pumps. This plan is resorted to from motives of economy only, and is by no means so safe as where there are two or more shafts, as, on the occurrence of an explosion, the partition or "brattice" is frequently either so much damaged as to be rendered useless, or is blown out altogether; and the colliery is thus deprived of the means of ventilation at the very time when it is most urgently required.

On the descent of the fresh air into the pit, it is necessary to communicate motion to it, and this is effected by making the "return-air," that is the air which has been through the mine, pass through or over a large fire, called "a furnace," placed at a short distance from the bottom of the up-cast shaft, by which it is rarefied and in consequence rushes with considerable velocity out of the mine by the "up-cast" shaft, whilst the space it occupied in the mine is rapidly re-occupied by the fresh air from the "down-cast" shaft. The furnace is from forty to sixty feet area and is kept burning without intermission. Thus a constant motion is given to the whole of the air in the pit at velocities varying with the necessities or circumstances of the colliery. Motion being thus given to it, the air becomes very manageable and is easily directed, in any requisite quantity, to the several parts of the mine for the purposes of respiration, or for diluting and rendering the dangerous gasses innoxious.

The air is guided in its passage through the mine, in the required quantities and directions, by the "stoppings," "crossings," and "trap-doors." The "stoppings" are brick or stone walls made perfectly air-tight, which are built across those "headways," "bordes," or other passages, through or along which the air is not required to pass. Partial stoppings, generally of wood, are used to diminish the area of any particular passage, so as to regulate the quantity of fresh air admitted in that direction. "Crossings" are tubes, arches, or tunnels, through which one column of air passes over or under another column; and "trap-doors," of which there are generally two placed at a short distance from each other, are doors placed across ways, in which the men and trams have to pass in going to or coming from the places of work, but through which the passage of the air is to be excluded. These doors are generally opened and closed by boys called "trappers;" in some instances mechanical means are used for this purpose. One door is only opened at once, so that an escape of air in a wrong direction may be prevented as much as is possible.

It was formerly the practice in the Newcastle district, and is so still in many others, to force the whole body of the air through all the works of the mine in one column; a practice which is replete with danger, disease, and death. In its course it necessarily gathers and carries with it a large proportion of noxious gasses, animal effluvia, and other impurities, which render it totally unfit for respiration, and which not unfrequently cause it to explode on reaching the furnace. The remedy for this evil is easily applied, and wherever it has been introduced complete success has been the result. It is this:—on its descent into the pit the fresh air is divided into a number of separate columns, sometimes into twelve or fifteen, so that each portion of the works is supplied with pure air, and the workmen nearest the up-cast shaft are as well provided for as those who are farthest from it. It not unfrequently happens, that in some parts of the mine such large quantities of gas are given out that it is impracticable to render the air non-explosive, it is not therefore permitted to mix with the other "return-air," or to approach the furnace, but is conveyed by a separate passage or "wind-way" to what is called a "dumb-furnace;" which is a drift or slanting chimney that communicates with the foul-air passage and the up-cast shaft at a considerable height above its base. The specific gravity of the fire-damp being less than that of air renders this plan easily operative. The greatest quantities of gas are generally given out in the "deads" or "goaves," and on removing the pillars of coal; and many destructive explosions have occurred in consequence of such parts of the mine having been imperfectly ventilated. The plan which has been described, of dividing the fresh air into several distinct columns, and sending it pure and unpolluted into each place of work, is called the "coursing system" of ventilation; the advantages which result from it are so obviously great, whilst the neglect of it is so prejudicial to the health, and dangerous to the lives of the miners, that its adoption ought not to be left to the caprice of the proprietors or managers, but made compulsory by the legislature.

The safety-lamp is intimately connected with this subject, as an auxiliary means for preventing explosions. Like most other improvements in mining engineering, we owe the discovery of this valuable invention to a calamitous explosion in the Felling Colliery, near Newcastle-upon-Tyne, which occurred on the 25th of May, 1812, by which ninety-one colliers were killed. The sympathy of the public was strongly excited by this accident, and was kept alive longer than usual by the occurrence of a repeated explosion in the same colliery, and of similar accidents in other mines of the same district. "It has been estimated" says Mr. Garbutt in his history of Sunderland, "that six hundred men and boys were destroyed (in this district) in the years 1812 and 1813, by these explosions, exclusive of many accidents of a minor description which were not noticed. To lessen the evils arising from this cause, a society was formed in Sunderland, in the latter part of the year 1813, under the designation of "A society for preventing accidents in Coal Mines." Soon after the institution of this society, Dr. W. R. Clanny, of Bishop Wearmouth, whose attention had been for some time devoted to the subject of explosions in coal mines, presented its members with a lamp, constructed on the principle of insulating the light, so as to secure safety in an atmosphere of fire-damp. The light was imprisoned in a strong glass jar, into which the atmospheric air, necessary for combustion, was propelled by a pair of bellows, through a stratum of water. For further security another stratum of water was placed above the light; and such was the arrangement, that the same blast of the bellows which forced the external air into the jar or lamp, expelled simultaneously an equal quantity of air within the lamp through the upper stratum or column of water." This lamp has undergone many alterations and improvements, some of them being very recent, but it has never been generally used in the collieries. It is however to the circumstance of Dr. Clanny having first demonstrated the possibility of so insulating a light as to prevent explosion in fire-damp, that we are indebted for the incentive to those subsequent discoveries by which the same object was accomplished, although by different and more simple means.

A lamp known among miners as the "Geordie lamp," invented by Mr. George Stephenson, the distinguished Civil Engineer, was first tried in the Killingworth Main Colliery, on the 21st of October. 1815, and "was carried in safety into a part of the mine where a strong blower of inflammable air was issuing."

On the 1st of January, 1816, a lamp invented by the celebrated chemist, Sir Humphrey Davy, was first tried in the Hebburn Colliery, and also answered the purpose. This lamp is called "the Davy" and is more generally used than any other; "the Geordie" and others being modifications of both these lamps, are only partially used.

These two lamps were constructed on the discovered principle that flame will not pass through small apertures of ascertained dimensions. Mr. Stephenson effected the object by insulating the light in an air-tight glass cylinder and supplying the air for combustion through tubes of small diameter fixed in the bottom of the lamp, the used air escaping by similar tubes at the top of it. Sir H. Davy enclosed the flame of his lamp in a cylinder of wire gauze, which he described in a paper addressed to the Royal Society, as made of "iron wire gauze of $\frac{1}{50}$ and of twenty-four apertures to the inch, or five hundred and seventy-six to the square inch, the cylinder is eight inches high and two inches in diameter."

The sanguine hopes that were entertained that this discovery would diminish the number of explosions, and considerably diminish the loss of life consequent upon them, have been grievously disappointed. The liability of these lamps to fractures and other accidents, and the necessity, there is of entrusting so dangerous an instrument to the keeping of men so notoriously careless and fool-hardy as the colliers generally are, has been productive of many accidents and a well-grounded want of confidence in them. In the report of a select committee of the House of Commons appointed in the year 1835, it is stated in evidence, "that during the eighteen years previous to the introduction of Sir H. Davy's safety lamp, in 1816, the loss of life in the counties of Durham and Northumberland by explosion was four hundred and forty-seven; whereas during the eighteen years succeeding 1816, the loss of life was five hundred and thirty-eight, occasioned not only by an increased quantity of working, but by an increased quantum of risk, occasioned by the working of fiery collieries, inaccessible previous to this invention; at the same time it was inferred that because of the use of the safety lamp, many precautionary means of safety previously practised, were abandoned." Instead therefore of the sacrifice of human life having been diminished by the introduction of the safety lamp as was anticipated, it appears that it has actually been increased. This unfortunate result has doubtless arisen, in a great degree, from a too great reliance having been placed on its protective power, instead of depending on a complete and thorough ventilation as the means of safety. It is very questionable whether any real advantage would have accrued to the workman, had the lamp realized all that was at first expected from it; as, it being the cheaper expedient, it is not improbable but that the ventilation would have been still more neglected, and the miners would have been compelled to breathe an atmosphere as fatal as explosions, although less obtrusive in its immediate effects. Yet I am by no means disposed to undervalue this invention, or wish it to be understood that no good has resulted from it. On the contrary I readily admit that as an auxiliary to, but not as a substitution for, good ventilation, it is an estimable discovery, and when used under proper and stringent regulations, with a strict attention to its indications of danger, explosions in many cases may be avoided.

From what has been said, it is evident that the safety of a mine altogether depends, first and principally, on the most complete and efficient ventilation; and secondly, on the use of the safety lamp instead of candles or other unprotected lights, in all those collieries in which fire-damp is known to exist. It has, I trust, also been shewn, that the simplicity and easy applicability of these means, render the universal adoption of them quite practicable; and although it is admitted that the most improved system of ventilation is yet far from being perfect, surely this is no sufficient reason why such available measures as we are acquainted with, should not be made use of to preserve from danger and violent deaths a bold and indispensable class of our industrial population.

Terrific and destructive as these explosions are, yet it is to other causes we are compelled to look for the greatest mortality in our collieries. Although 50 or 100 men are too frequently killed by a single explosion, yet these occurrences are comparatively rare; whilst deaths from other causes are constantly happening, and in the aggregate constitute a much larger amount. Of these, the most common is next to be considered.

FALLS FROM THE ROOF.

II.

Accidents from stones or coal falling from the roof of the mine on the men, whilst they are at work, are very numerous, and in a majority of cases are either instantly or ultimately fatal; whilst those who escape being killed, are generally disabled for life by broken limbs and severe contusions. Most of these accidents arise either from an insufficient number of props, or from their being placed improperly, or after too great a lapse of time. The rotting of the timber used for propping up the roof, is also a frequent cause of them, especially in ill ventilated mines. In many collieries these accidents might be altogether avoided, and in others materially diminished, by the exercise of great care and vigilance, and by a liberal supply of timber for props.

Experience has proved that without some such stimulus to watchfulness and liberality in this respect, as would be induced by an official inspection of a Government Agent, and by an impartial and searching enquiry into the causes of deaths occasioned by falls from the roof, whenever they occur, there is but little reasonable hope of any improvement. The enquiries instituted by the Coroner into the causes of fatal accidents of this description are utterly inoperative of good. These accidents are so common, that at most inquests they are considered so much in the light of an ordinary and uncontrollable event that a verdict of "accidental death" is returned as a matter of course, without any other enquiry being instituted than the identification of the body, and to ascertain the fact that the death was caused by a fall from the roof.

In most districts the cost of timber for props is a considerable item in the expenditure, varying from seven to twenty per cent on the value of the coal obtained; hence the safety of the men is too often sacrificed to an attempt to economise in this necessary outlay in order to increase the profits.

The nature of the roofs differ so much, that no general rules of universal application can be laid down as to the exact quantity of timber or other props required in every pit, but there is little difficulty in determining this question on a careful personal examination.

By referring to the evidence obtained by the Children's Employment Commission, we are told that the dangerous practice of "robbing the post wood" or props, prevails to a fearful extent. In speaking of the collieries near Oldham, the witness, Mr. Joseph Wild, says:—"The chief accidents are from fire-damp, and from falling in of roofs, or of stones from the roof; the former chiefly through incaution on the part of the men or of the children; and the latter from the ignorance of unpractised getters, or a stinginess in the smaller employers as to their supply of wood for props; a cause which is more general than is usually made to appear at the Coroner's inquests, because the feelings and interests of the witnesses tend to conceal it. Parties after giving their own account of accidents in conversation, could not be got to depose to the same facts before the Coroner. A common thing is for a master to leave the men to "rob the post-wood" as it is termed, to supply the wants of their hewing; or in other words to fetch away the wood from the old workings to an extent which, in the want of any other supply, has been carried to an extreme of great danger. This has been repeatedly given in evidence before the Coroner."

In some districts the working of the coal is let to contractors, who engage to deliver it on the bank or surface at an agreed price per ton or measure; in which cases the "timbering" or "propping" of the roof devolves upon them. The carelessness and avarice of this class too often induce them needlessly to expose the miners in their employment to almost certain danger, by not supplying them with a sufficient quantity of timber. The remedy for this evil would be in prohibiting owners from devolving this important duty on the contractors, and compelling them to entrust the supply and proper application of the timber to the direction of a competent person in their own employment.

It may be observed, that a good ventilation is a great preservative of pit timber, and that in mines in which it is imperfect, the rapid destruction of the props is very great. Many fatal accidents are owing to this circumstance; and great labour and expense are thus incurred, as well as loss suffered by the frequent interruption of the transit of the coal and waggons in the mine, and consequent temporary suspension of the works. With a fall from the roof there also frequently occurs a considerable irruption of fire-damp, and the ventilation being stopped or impeded by the fall, an explosion, more or less destructive to both life and property, is the consequence.

It is obvious, therefore, that a thorough ventilation, whether adopted voluntarily or by compulsion, will be highly advantageous even in a pecuniary sense, as certainly as it would be beneficial to the work-people, by diminishing the risks to which they are daily exposed, of being mutilated or killed by falls from the roof.

ACCIDENTS IN THE SHAFTS.

III.

These accidents are generally fatal, and unfortunately are very numerous. It is to be lamented that they cannot always be prevented, notwithstanding all known precautionary means are used for that purpose. Yet this admission by no means implies that the means of prevention are generally resorted to; on the contrary, the impunity with which they may be neglected, has induced an utter indifference towards safety in some districts, which appears almost incredible.

By the reports of the Commissioners, already quoted, it appears that the deaths occurring from the accidents in shafts, constitute a large proportion of fatal casualties of a mine. In the district of South Staffordshire, it is stated that in 117 violent deaths which occurred in the collieries of that district in the year 1838, twenty-eight were killed in the shafts. In the East of Scotland, of thirty-six men that were killed in the mines, 18 were destroyed in the shafts. In the West Riding of Yorkshire 29 persons were killed in the shafts, the total number of fatal accidents in the mines of that district being 50. By a register of the accidents in some of the mines in Lancashire, it appears that in 22 violent deaths, 10 happened in the shafts. Thus, in only four districts in which an imperfect register has been kept, we find that of 225 persons who lost their lives in the collieries, 85 deaths were owing to the accidents in the shafts.

Many of these accidents are caused by the mouths of old and abandoned shafts being left open, and without walls or other description of fence being erected round them; so that persons passing near them in the dark, or those who are unacquainted with their exact locality, fall into them and are killed.

In South Staffordshire, the Commissioner states as the cause of many accidents "Men falling down the shafts of working and abandoned pits;" and in the report on the Derbyshire district we are told:—"In most of the fields I visited, the pits were left exposed either for man or beast to fall into, and many accidents occurred in consequence. Such a state of things plainly indicates the unwillingness there is in the neighbouring population to institute any legal proceedings against such powerful parties as the coal owners, and shews the necessity there is for compelling an observance of the law, in this respect, by Government interference.

The dreadful deaths consequent upon the chains or ropes breaking whilst the work-people are descending or ascending the shafts, are very numerous; many of which might be prevented were the requisite means used for that purpose. By the Commissioner's reports it will be seen that these accidents are of common occurrence in almost every district.

In South Staffordshire the causes of many accidents is said to be:—"The breaking of the chain whilst the miners are on it, going up or down the shaft, by which they are precipated to the bottom and dashed to pieces. When the miners come up the shaft, it has occurred that the persons on the bank do not attend to the engine in time, and the miners are carried up and are precipitated over the pully and dashed to the ground and killed. In every such case the negligent parties ought to be sent to the assizes."

Of the Derbyshire district, the Commissioner says:—"I wish to call your attention to another source of fatal accidents; it is the employment of children to have the sole care of the steam engine. I met with more than one instance of children only ten years old having the lives of the colliers left to their mercy, and have seen others so inattentive to their duty as to let the corve be drawn over the pulley, and half a ton of coals thrown the distance of a hundred yards or more down the shaft, but notwithstanding these accidents occurring in the immediate neigbourhood, the practice of appointing children to this responsible post still continues in the most respectable fields."

In the collieries near Oldham we are told:—"There is a class of accidents, of which children employed at coal works in this neighbourhood are the causes, to persons of all ages. These occur in the winding up by the steam machinery of all persons out of the pit. It is a general system here to employ mere children to tend these engines, and to stop them at the proper moment; and if they be not stopped the two or three or four or five persons wound up together, are thrown over the beam down into the pit again. The inducement to employ these children in circumstances where life and death depend on their momentary attention, is merely that their services can be obtained for perhaps 5s. or 7s. a week, instead of 30s. a week, which the proprietors would perhaps have to pay to a man of full years and discretion. There have been people wound over at Oldham edge, at Werneth, at Chamber-lane, at Robinhill, at Oldbottom, and on Union Ground here, within the last six or seven years. Does not know a case in which children were not the engineers; and though he (the witness, Mr. Joseph Wild) cannot speak to all of them being such, it was generally the case in these instances. Three or four boys were killed in this way at the Chamber-lane colliery, two or three years since, by the momentary neglect of a little boy, who he thinks was only nine years of age, and who he heard, after the worst was over, had turned away from the engine when it was winding up, on his attention being attracted by a mouse on the hearth."

These extracts shew that the breaking of chains is a cause replete with danger and loss of life. By the substitution of flat ropes for chains, the number of these accidents might be very considerably diminished, if not altogether avoided. Chains are peculiarly unfitted for this purpose. The great difficulty, if not impossibility, there is of ascertaining the soundness of a chain either by a close inspection of each link, trying them with a hammer, or by other means, is well known to every one practically acquainted with the subject. I have repeatedly had the mortification of seeing chains break, which were used on steep railway inclined planes, immediately after a most careful examination of every link, which presented to the eye no appearance whatever of flaws or fractures, and gave out a clear ringing sound on being struck with a hammer. It is obvious therefore, that in the use of chains for this purpose, great risks are encountered, which neither care nor vigilance can prevent, and that the use of them ought to be strictly prohibited.

The use of common round ropes is also objectionable. It is true that accidents may be, and have been frequently prevented by great care, where this description of rope is employed, but this necessary vigilance is in too many cases neglected, and many dreadful deaths have ensued which would have been prevented had flat ropes been used. When round ropes have been long used, they break short, like a chain, without giving previous indications; but generally they break piecemeal, one strand first giving way, and then another, so that if carefully watched, and immediately attended to, they may be repaired before a total fracture takes place. But if, as is too frequently the case, the repairs are postponed until it be more convenient to stop the works, or the rope is hastily and imperfectly mended, the probability is that it breaks whilst the men are on it ascending the shaft, when from six to twenty poor fellows are precipitated to the bottom of the pit and instantly killed, whilst the usual verdict of a Coroner's jury, in such cases, assures the public that the deaths were accidental. In the North of England these accidents are of comparatively rare occurrence, notwithstanding the great number of collieries there are in that district. This highly creditable fact is attributable to the excellent regulations and liberal management with which these large works are conducted, which has induced a system of ever watchful superintendence in every department, and a willing adoption of any known improvements in the means and appliances for the prevention of accidents. One of these, was the introduction of the flat rope, which is made of three or more ordinary round ropes placed parallel with each other, and then strongly stiched together. Each strand therefore of a flat rope, is in itself a complete rope; and any failure in it is as easily detected as in a common rope, whilst the probability of the whole suddenly breaking is very considerably diminished. Several years' experience has indubitably proved the superiority of this description of rope, nor would it be an unreasonable provision, were the use of chains for this purpose prohibited by an Act of Parliament, and the employment of flat ropes only, made compulsory.

The employment of boys to work and manage the drawing engine is so obviously improper, and evinces such a culpable disregard to the safety of the men, as must convince every one of the absolute necessity there is, either for a better and more efficient administration of the existing laws, or for the enactment of new ones that will protect the miners from being exposed to needless risks by the avarice of their employers.

Besides the necessity there is for using the best description of ropes only, and employing properly qualified men to have the care of the drawing engine, a system of constant and close inspection of the ropes and machinery by a competent person, ought to be instituted in every colliery establishment, and when accidents happen, a rigid and impartial inquiry into the circumstances attending it ought to be entered upon, to ascertain the true cause of it; the particulars of which ought to be entered in a book kept for the purpose of registering all the accidents which may occur in the colliery.

Fatal accidents owing to the falling of stones or pieces of coal on the men whilst they are in the shaft, are, unfortunately, of common occurrence. They arise from substances falling down the shaft from the top and sides of the shaft, and from the corves or boxes containing the coal whilst ascending from the pit. Although it is admitted in this, as in other cases, that it is impracticable altogether to prevent these accidents, yet many may be avoided, and others rendered less destructive, by very simple precautionary means. These are:—by having all the shafts in which the men pass up or down, lined with ashler or brick work, laid in mortar or cement:—to raise the top or mouth of the shaft by a kerb of one or two feet above the surface platform or "settle-board," by which the coal strewed about on it, would be prevented from being unintentionally shoved or kicked down into the shaft; and by having an iron canopy or umbrella fixed on the rope above the "corves," or "cages," and the men in the "loops" so as to protect them from falling bodies. These umbrellas have been in use for some time in the Newcastle coal-field, and the benefits derived from the use of them are universally admitted.

These preventives of accidents in shafts are not only obviously practical, but have been proved to be efficacious, and surely there can be no reasonable objection to rendering the adoption of such measures obligatory by law on those coal owners with whom other incentives are insufficient.

INUNDATIONS.

IV.

Casualties from this cause are less numerous than from those already noticed, but when they do occur, the loss of life occasioned by them is little short of that caused by explosions. The ostensible causes of these accidents clearly indicate the means that ought to be resorted to in order to prevent them.

One of the most calamitous inundations on record happened in the Heaton Main Colliery, near Newcastle-upon-Tyne, on the 3rd of May, 1815. From the published accounts of this catastrophe we learn:—"That the workings of the colliery at this time were in one of the lower seams, at a very great depth, having a considerable dip, or inclination from one side to the other, the shafts being on the lower side. The upper and neighbouring seams had been wrought as a colliery under the name of Heaton Banks, by shafts distinct from the present workings, and which shafts, when the colliery was given up, were covered over with boards and earth. In the course of time these old workings had become entirely filled with water, which at about half past four o'clock on Wednesday morning, broke through the roof where the strata are disturbed by a dyke, and inundated the workings. The water rushed in with dreadful rapidity, and flowing naturally to the lower parts of the workings, soon cut off the only means of escape, by closing the lower mouths of the shafts, in which the water soon rose to the depth of nineteen fathoms. Exertions were immediately made to reach the spot where the men were supposed to be, but without success. The old colliery is said to have been discontinued (about 70 years before) on account of the influx of water, which was so great that seven engines, of the construction of that day, could not get the better of it. By this catastrophe 75 persons (41 men and 34 boys) lost their lives. From various difficulties, the bodies of these unfortunate men were not arrived at, until upwards of nine months from the time of the accident. The sufferers who thus found a living grave, left 24 widows and 77 orphans, besides Mrs Miller and her eight children, to deplore their untimely fate." †

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† Local Records of remarkable events which have occurred in the Counties of Northumberland and Durham. By John Sykes. 1st Ed. p. 273.

In reporting on the Cumberland coal-field, the Commissioner mentions an inundation "which occurred in Mr. Curwen's pits, near Workington, about two years ago, from an irruption of the sea" which he says "was foretold by many." It appears that the seam of coal rose under the sea, so that in working it, every step brought the colliers nearer to the water. They had proceeded a considerable distance with the workings,—I believe nearly two miles, in a direct line from the shore. The salt water is said to have oozed through, and some of the men had heard, or said they heard, the sound of the sea above them. So great was the apprehension, that some of the colliers left their work, and others were only induced to stay by a higher amount of wages. At length the water rushed suddenly in, and though some who were near enough the entrance escaped, about forty fell victims, and remain to this hour in the pit."

"In the month of February last" (1844) says Mr. Dunn in his "View of the coal trade," after alluding to the accident mentioned above, "a very similar and equally lamentable catastrophe occurred at Landshipping, in the County of Pembroke, where by the sudden inundation of the river under which the colliery was working, no less then forty men and boys perished, as well as the instantaneous filling with water, of the whole of the extensive works. It is said, that in those parts of the workings where the accident occurred, only a few feet of rock, underneath twenty yards of sand, separated the waters of the river from the bed of coal; that the workings had for some time previous been discontinued in that quarter, but that in an unfortunate moment they had been resumed, and the obvious consequence followed. So slight, indeed, was the separation from the waters, that the very timbers of the mine arose through the fractured part, and were seen floating round the spot." *

The inundation at Heaton is attributable to there having been no plans of the old colliery extant; could such have been consulted, the danger would have been too apparent not to have been avoided. It had been usual in this colliery to drive exploring headings in advance of the general work, and when it was supposed to be approaching a certain distance of the old workings, the process of boring was resorted to, so as to ascertain the proximity of the water, which, though attended with danger, were the only precautionary means that could be resorted to in the absence of plans or maps. When the inundation occurred, some inadvertence, it seems, had been committed in not prosecuting these measures with sufficient care, and the disastrous result ensued.

* p. 102.

In the other two cases it does not appear that any plans were kept or consulted, a negligence which is too common in many districts, and is replete with many evil consequences. In both instances great and culpable mismanagement was shewn by the superintendents of the mines, yet both they and the proprietors escaped with impunity.

The proprietors of all mines ought to be compelled to have correct plans of their works; duplicates of which ought to be kept and registered by Government, in each district, to which ready access ought to be permitted under proper regulations. Many important benefits would result from such a registration. Accidents, such as those just mentioned might be avoided, or if incurred, the neglect would be rendered too apparent to escape without reprehension or punishment. In mines wherein the ventilation is imperfect, the inquiry into the causes of accidents, whenever they may happen, would be greatly facilitated by having correct plans of the workings to refer to; any proved defects might thus be pointed out, and such instructions given, as, if carried into effect, would prevent a recurrence of such casualties in future. It would also greatly aid any system of inspection that may be instituted by the legislature, without which, there is every reason to fear, any Government interference would be inefficient. It would also elicit a great mass of valuable practical information; and would, most probably, induce a great improvement in the mode of working and ventilating mines, by contrasting the different methods pursued, as shewn on the plans, and a generous rivalry would be excited among the owners, to excel in the working and management of their respective collieries. The Registration Office would become an unobtrusive Normal School, as curiosity would prompt many incompetent persons who have the management of mines to inspect the plans of their neighbours; and they might thus derive valuable instruction, who would not ask for information, or attempt to obtain it from books; and when sound practical knowledge is acquired by such persons, I have observed, that it is not long before they make use of it. It is their pride, and not their inclination, that keeps them in ignorance; and in this way they would obtain the knowledge, of which they are so much in need, without any sacrifice of feeling, and acknowledgement of their inefficiency.

The registration of plans has been often and strongly recommended by committees appointed to enquire into the causes of the accidents in mines and by writers on the subject, but without success. And although some repugnance to it may be shown by interested parties, It is obvious that any Government measures for the prevention of accidents would be incomplete without the registration of plans.

MISCELLANEOUS CAUSES.

V.

In this class many accidents are comprised which are common to all large works, and although the number of violent deaths consequent upon them is, in the aggregate, very considerable, it is somewhat difficult to enumerate every cause of them. Experience has taught us that these casualties are most numerous in badly managed and ill-ventilated mines; the remedial measures therefore, which have been previously suggested would prevent, if carried into effect, the occurrence of many accidents under this head also. In all large works, the avoidance of accidents to the men employed, greatly depends on the regularity and order with which they are conducted, and in no case is this more evident than in mining operations; whatever, therefore, induces to this end, insures not only the good performance of the work, but also the safety and comfort of the men.

The imperfect drainage of mines, although immediately not the cause of sudden deaths, yet it so materially affects the health of the miners, as to require some notice in this discussion. Good and complete drainage is so directly beneficial to the owner, that it is surprising to find it so much neglected as it is in many districts. The maintenance of the "ways" or roads in the pit cost so much less when kept dry, and the "haulage" or conveyance of the coal underground is so much cheaper in consequence, that the outlay requisite to make the drainage good is speedily and amply repaid. The timber for props would last longer, and there would consequently be fewer falls from the roof. There ought therefore to be no objection to proper drainage being made obligatory, as one of the means for preventing accidents.

RECAPITULATION.

The several measures which have been proposed as remedies for the existing evils, the general adaptation and practical utility of which have been proved by experience, may be recapitulated as follows:—

First.—Every mine ought to have at least two shafts, an up-cast and a down-cast shaft; the area of the up-cast shaft being greater than that of the down-cast shaft, to permit the unimpeded passage of the return-air after its volume has been increased by the warmth of the mine and by its rarefaction in the furnace.

At the bottom of the up-cast shaft and at a short distance from it, a large fire or furnace ought to be kept constantly burning, the area of which ought to be from 40 to 60 feet, according to the extent of the works and the peculiar circumstances of the mine. In collieries where great quantities of fire-damp are given out in the goaves, in the pillar, or other works of the mine, the return-air from such places ought not to be allowed to mix with the other return-air, but conveyed through a separate air-course to a dumb furnace as already described. The whole of the wind or air-courses ought to be frequently examined, and any falls from the roof or other causes of interruption to the free passage of the air ought to be instantly removed.

As the quantity of air which will pass through a mine in any given time depends on, or is equal to its velocity multiplied by the area of the air-course or wind-way, this should always be sufficiently large to admit the passage of a free current, much greater in quantity than is ordinarily required for good ventilation, in order to provide for a reserved power of instantly introducing a large additional quantity of pure air into the mine on the occurrence of an explosion, and at those times when the diminished pressure of the atmosphere, as indicated by the fall of the mercury in the barometer, induces a greater than ordinary influx of the obnoxious gases into the mine.

On its descent or ingress into the mine, the fresh air ought to be divided into as many different columns as there are working places and waste districts in the mine, in such proportions as the distance it has to travel, and the extent of the area to be ventilated, requires. All the stoppings ought to be constructed of masonry and made perfectly air-tight. In the main passages or ways, the trap-doors ought always to be double, and one only opened at once; care should be taken to make a judicious selection of boys to be employed as trappers, and as soon as any perfect mechanical means are devised to answer the same purpose, the employment of boys ought to be prohibited.

In cases where the coal on being worked, gives out more than an ordinary quantity of gas by blowers or otherwise, a constant current of fresh air ought to be directed by stentings or wooden partitions, up to the face of the work.

In all mines, wherein fire-damp is known to exist to a dangerous extent, the use of candles, common lamps, or other unprotected lights, ought to be strictly prohibited and the exclusive use of the most improved safety-lamp, under proper and stringent regulations, made obligatory.

The danger of using candles in such parts of a fiery mine as may be supposed to be free from fire damp, and safety lamps only in those parts which are known to produce so much gas as to be explosive, was shewn by an accident which took place in the Ardsley Main Colliery, near Barnsley, on the 5th of March, 1847, by which 73 lives were lost. In his evidence given before the Coroner's Jury, Mr. Joseph Littlewood said—"I am fireman to the Oaks Pit. My duties are to go down into the pit first, to see that it is in working order, and fit for the men to work in. There has always been foul air in the breaks where the coal has been got. The reason there is foul air in the breaks and not in those which are being worked is, that in the breaks which have been worked the roof has fallen, and the air cannot get thoroughly into them; the props and puncheons in the old breaks are "borrowed" that is taken away as the work proceeds. The men have worked in this pit both with candles and safety-lamps. I have told the men to work with candles in the breaks, where I have found it safe, in my opinion, so to work. I have told them to work in the breaks, near the old breaks, with lamps. I told them this, because I found the air in the breaks they were to work in, fired at a safety-lamp with the gauze on. They might go a little into the breaks where the lamp fired with the gauze on, but not too far. The lamps are cleaned by the colliers themselves at home, after their work. They are not locked. They are not examined when the men go into the pit, to see that they are clean. This is left to themselves. The lamps burn with oil. If there was any oil in the gauze of a lamp, and the man took that lamp into a break such as I have mentioned, to work where the air fired, the oil would take fire and cause an explosion. If the lamp was not clear from oil, an explosion would take place where the men had been in the habit of working. There would be about 100 hands in the pit at the time of the explosion last Friday. They were in different parts of it, and I only know one of the number who escaped without injury.

There is a scaffolding in the air-shaft for the purpose of repairs. I dont know how long it has been in. I should say the space between the scaffolding and the sides of the shaft is about two feet. The shaft is about nine feet wide and is circular. There was no person in authority down, when I left the pit on Friday last, nor when the explosion took place. I cannot account for the explosion. When I find foul air in the break where the men are to work, I lay a shovel across it, to signify this. They know then they are to take lamps in, and not candles. When a fresh man comes to work, he is told this signal. It is possible a man might come to work, and I not know. He might work awhile before I saw him, and not knowing the signal, might walk over a shovel with a lighted candle in his hand. There was no fine for a man working in the pit with a candle where he ought to use a lamp. About a year ago I found a man named Walton, and who is now amongst the killed, working with a candle where he should have been using a lamp; he was threatened to be turned off, but was not.

The gauze of some lamps is finer than others. They are both equally safe. I use coarse gauze, because I can see the foul air sooner."

In the above extracts there are facts elicited which prove most conclusively that the regulations for the prevention of explosions, were very imperfect in design, and the mode of carrying them into effect exceedingly defective. At the time when the accident happened, it appears that the area of the up-cast shaft was diminished at least one third, by the scaffolding which was suspended in it; and yet, although the mine was known to be in such a state, that the merest casualty would cause an explosion, 100 men were sent into it with the only means of ventilation thus retarded and diminished. The mode of warning the men of the existence of fire-damp in the breaks, was by placing a shovel across the entrance, which might easily be kicked or shoved aside by persons passing; and notwithstanding the well known repugnance which the pitmen entertain to using the safety-lamp, it appears that their attention to these signals of danger was left to their own discretion; that when they went to work, supposing the shovel to have remained in the position in which it had been placed by the "fireman," there was no one in authority present to enforce obedience, and if it were neglected, the offenders escaped with impunity. The use of candles at all in this pit was attended with very great risk, and the absence of all requisite caution as to the state of the safety-lamps when they were taken into the pit, was replete with danger. The witness, to whose keeping the lives of the men were entrusted, appeared to be ignorant of the principle upon which the lamps are constructed, for he is reported to have said—"The gauze of some lamps is finer than others. They are both equally safe. I use coarse gauze, because I can see the foul air sooner!" Whereas it is an established fact that all lamps constructed of gauze, the openings of which are more than 576 in a square inch, are as ineffective as a lighted candle in preventing explosions.

As the advantages to be derived from the Davy or other safety-lamp altogether depends on its always being in a complete and perfect state, and as the wire-gauze lamps, which are the most generally used, are liable to many accidents and consequent derangements, the utmost vigilance and care is required to maintain them in an efficient state. Accidents may happen from one or more of the meshes being broken, by having been exposed to the corrosive effects of mineral waters or to the rapid oxidation by moisture alone, independent of fractures from blows or pieces of stone or coal falling on the lamp; the danger arising from which is evident when we consider that the breaking of a single wire by enlarging the aperture would caüse the flame of the lamp to communicate with the fire-damp and cause an explosion. If the gauze of the lamp be oily, the flame of the lamp will be communicated to the oil on the outside of it, by the heat of the gauze wire; which, though even at a red heat, does not communicate flame to fire-damp, yet will instantly ignite oil, and thus set fire to the gas and cause an explosion. There is a very general repugnance among pitmen to the use of the safety-lamp, owing principally to the small quantity of light it gives out, and it has not unfrequently happened that explosions have been caused by their unscrewing and taking off the wire-gauze cylinder, either for the purpose of obtaining more light, trimming the lamp, lighting their pipes, or from some other motive; it is therefore necessary to lock the lamps, and to prohibit, under severe penalties, their being opened in the mines.

The following regulations, which are founded on those pursued in the best managed collieries, wherein it is necessary to use the safety-lamp, ought to be stringently enforced in all fiery mines:—

The use of that lamp which has been proved to be the most effective in preventing explosions, ought to be made imperative.

That no lamp should be allowed to enter a mine, unless first inspected by a competent person, who ought to see that it is in perfect repair, that the gauze is free from oil and dust, and the lamp properly trimmed and supplied with oil.

That after having been so examined, and before the lamps are allowed to be taken into the mine, each of them ought to be securely locked by the inspector, and the key retained by him, and any one opening or taking off the gauze of a lamp in the pit, ought to be severely punished.

That if the wire-gauze or glass of any lamp be broken or injured whilst in the pit, it ought to be instantly extinguished by the man in whose possession it may happen to be at the time of such an accident.

That the inspector ought to be made responsible for the lamps being in a proper state, when they are given to the men for the purpose of being taken into the mine, and he ought to be punished for neglect or carelessness in the performance of his duties.

SECOND.—Falls from the roof would be much less frequent and less fatal in their effects, if all mines were well and sufficiently timbered, under the constant superintendence of a competent person in the service of the proprietor.

THIRD.—The surface-opening or mouths of all disused shafts should be substantially and safely closed, and those of working shafts effectually fenced in. The use of chains ought to be prohibited, and flat ropes exclusively employed for lowering men into, or raising them up the shafts; and both ropes and machinery used for this purpose should be daily inspected by a competent person. The drawing engines ought not to be entrusted to boys, but to properly qualified men. The use of iron-canopies or umbrellas ought to be made imperative, and all the shafts ought to be lined with bricks or stone laid in mortar or cement.

FOURTH.—That duplicate plans of the workings of all mines be deposited and registered in some central place in each district, under the care and superintendence of a Government Agent.

FIFTH.—That all mines be well drained, and the underground roads, tram-ways, or railways be kept in good order. That efficient sanitary rules and regulations be instituted in all mines, and rigidly enforced.

Experience teaches us that there is little hope that any of these requisite measures will be carried fairly and fully into effect, without some system of occasional personal inspection by a Government Officer. In many instances, in which fatal accidents have occurred, the existing laws have been violated with impunity; and unless some means be devised to carry them invariably and impartially into effect, little good will result either from improving the old or making new laws. Any legislative measures, therefore, for the prevention of accidents in mines, in which official inspection is not an integral part of the scheme, will be very incomplete and in a great measure inoperative.

To render the services of an Inspector as efficient as possible, it will be necessary to institute certain measures by which he would be enabled to form an opinion of the state of the mine at any and all times previous to his visit. For this purpose every mine ought to be provided with proper instruments, and correct observations ought to be taken daily and registered in a book kept for that object. These instruments are an Anemometer, Barometer and Thermometer. By the first the velocity of the air in the pit might be ascertained, which when multiplied by the area of the passage or way in which it was taken, would shew the quantity of air entering or escaping from the mine in any given time; which would not only surely indicate any stoppage of the air courses by a fall of the roof or from other causes, but would also enable the Inspector to determine whether the existing means of ventilation were sufficient; and in case of an explosion these records would materially assist him in ascertaining the cause of it, and in advising remedies to prevent a recurrence of such accidents.

The rising or falling of the mercury in the barometer, by indicating the increased or diminished pressure of the atmosphere, would intimate that a greater or less quantity of gas was exuding into the mine, for it is always produced in the greatest abundance when the pressure of the atmosphere is the least, and at such times more fresh air is required to ensure safety than on ordinary occasions. If there be no means of forcing into the pit an extra quantity of pure air at such times, the men ought to be withdrawn from it, until the rise of the mercury in the barometer indicates safety.

The thermometer is a useful auxiliary to the barometer, an increase of the usual temperature of the mine being always a suspicious circumstance and generally indicating an interruption to the ventilation.

These instruments ought to be placed in the charge of the resident engineer or viewer, and he ought to be made responsible for the correctness of the observations and the truth of the register.

The advantages which result from the use of these instruments are so obviously important, as to make it a matter of surprise that they are so very rarely employed; and the expense of them is so trifling, that it is difficult to assign a motive for the very general neglect which is evinced by the owners and managers of mines to avail themselves of the benefits accruing from them.

Were all the remedial measures for the prevention of accidents in mines which have been suggested in the foregoing pages carried into effect, there can be no doubt whatever that the miner's occupation would be divested, to a very great extent, of those fearful dangers and great mortality to which it is now exposed. The past and present state of our mines, and the mode of managing them, proves the necessity there is for an improvement, the practicability of which has been demonstrated, whilst experience has shewn the inutility of existing laws, as well as the necessity there is for legislative interference, for the purpose of instituting more efficient measures for the protection of the British miner.

The expediency of legislative interference with mines, has however been questioned, and numerous objections have been urged against it. It has been said that there are means already in existence by which culpable negligence causing the loss of life, may be punished; and that this punishment and its consequences are sufficient to deter parties from unnecessarily risking the lives of the work people. In his charge to the Grand Jury of the County of Durham at the Spring Assizes in 1824, Mr. Justice Bayley said, in alluding to an explosion in a colliery by which many lives had been lost:—" If those persons who had the care of such concerns did not use proper precaution, (whether that want of caution arose from the use of improper lamps, or from whatever other cause) in the event of death ensuing, they would be liable to the charge of manslaughter."

Upwards of twenty-three years have elapsed since this warning was given from the judgement-seat, during which period many explosions have happened and thousands of lives have been lost; yet I am unacquainted with a single instance of any person having the care of such concerns, having been convicted, or even tried, on a charge of manslaughter, although, in very many cases, proper precautions were not used. The law, therefore, as it now exists, may be abstractedly good, but in its administration it is inoperative, from not being impartially and universally put in force.

However excellent in many respects the institution of coroner's inquests undoubtedly is, yet, from a variety of causes, they are ill-adapted as a court of legal inquiry into these cases. This very probably arises from the mode in which these courts are constituted.

The coroner is generally a respectable solicitor, residing and practising his profession in the district where the accident happens. If the proprietors of the mine in which the accident has occurred, and into the cause of which the coroner has to inquire, be not clients of his, it is more than probable that some of their connexions or friends are, and without ascribing any partiality from improper motives, we may presume that a bias may be given to the inquiry, insensibly perhaps to the Coroner, but nevertheless unfavourable to that inpartiality with which the proceedings ought to be conducted. Nor are the usual attainments of an attorney-at-law to which profession the Coroners generally belong, such as to enable them so to conduct the inquiry as to elicit from the witnesses those facts which are essential to the development of the real causes of the accident; whilst on the other side the whole resources of the engineering staff are brought into requisition, and naturally enough endeavour to soften down the facts and suggest inferences favourable to the owners. Under such circumstances it is not surprising that the evidence adduced, should be principally of an exculpatory nature. Another cause of the inefficiency of those courts, is the great difficulty of obtaining proper persons to serve on the juries. On this subject the sub-commissioner in his report on the iron works and collieries in South Wales says:— "It has been represented to me that in cases of fatal accidents, which, however, have not been of sufficient magnitude to rouse public attention, many difficulties lie in the way of obtaining an impartial inquiry, from the jury in many instances being selected from the fellow workmen of the deceased, and who are unwilling to hear, even if they think it necessary to call, evidence which may probably involve either their employers, or any employed in the same work with themselves. And it is not improbable that, from the difficulty of carrying out the useful objects of the office of Coroner, the benefits to be derived from a proper administration amongst a population so exposed to frightful accidents as those engaged in the iron works, are not duly appreciated."

"The gentleman last named," (Mr. Reece, of Cardiff) further stated, that in mining districts the workmen formed the juries, and, as a matter of course, none could be found to return verdicts, or levy deodands, by which their employers would be injured. The mode of conducting inquests, concluded that gentleman, as at present, is more injurious than useful,—proprietors and culprits escape. Mr. Reece informed me also, that many times he had been obliged to take a jury from Cardiff into the country, as the people were so ignorant and so prejudiced that it was almost impossible to persuade them to return proper verdicts."

This evidence is more important from the circumstance that Mr. Reece is a highly respected Coroner in the district of Glamorganshire which embraces places in which the most extensive mining operations, for obtaining both coal and iron stone, are carried on.

With a court of enquiry thus constituted, it is not surprising that the verdicts should so very generally rather shield, than punish and expose, culpability. It cannot be disproved that in many cases "proper precautions" have not been taken, facts to the contrary being too notorious; of what value then is the "liability to a charge of manslaughter" mentioned by Mr. Justice Bayley, and what amount of protection do the miners derive from it? The reports and evidence of the Children's Employment Commission indubitably prove that of the thousands who have been destroyed by the accidents in our mines, carelessness, ignorance, or avarice, or all combined, have, in very many instances, produced the fatal calamities which deprived these men of their lives, yet the owners and managers have not only escaped without punishment, but have been exonerated from all blame by verdicts of coroners' juries stating that the deaths were "accidental." The evidence of Mr. Reece, who has had ample opportunities of forming a correct estimate of the value of these courts, is decisive as to their inefficiency,—he says "the mode of conducting inquests, as at present, is more injurious than useful.—proprietors and culprits escape"

It appears, therefore, that the laws relating to violent deaths in mines, as well as the mode of administering them, urgently require revision and improvement; as at present they are inffectual in deterring parties from needlessly risking the lives of their workmen, and are inoperative in punishing them when they do so. The precise nature of these improvments I leave to those better versed in legislation to suggest, but I may perhaps be permitted to state that no system of inquiry can, in my opinion, be really efficient unless it be conducted with the assistance of an inspector or engineer thoroughly conversant with mining operations.

It has been said that the publicity which is given to the proceedings of a Coroner's inquest has a very beneficial effect. Were these proceedings what they ought, and were designed to be, and if the evidence adduced was invariably published, there is no doubt but that it would have a very salutary effect. Except on those occasions when a great number of lives have been lost by an explosion or inundation, it very rarely happens that any portion of the evidence is published, but a brief notice appears in the newspapers of the district, merely stating that an inquest was held and a verdict of "accidental death" returned; which is a paragraph of such ordinary occurrence as to excite neither attention nor remark. Many inquests are held and violent deaths occur, of which persons in the immediate neighbourhood are ignorant, and which are never noticed in the newspapers. So that as far as publicity is concerned, it is only very partially and imperfectly obtained in this way, and constitutes a very feeble check on the conductors of these large works, to whose keeping the lives of so many men are entrusted.

"In Scotland there are no Coroners to inquire into sudden and violent deaths; and serious accidents of an appalling nature frequently occur, and no notice whatever appears to be taken of them;"—says the Commisioner in his report on the collieries of the East of Scotland, in which he is fully borne out by the evidence.

Mr. Marshall of the Netherwood colliery states:—"That six weeks ago a boy met his death by a hutchie passing over his body and crushing him; he never spoke after: and another boy was crushed to death by a falling stone from the roof. Two men were killed by the roof falling. It is not the custom to notice these accidents; we neither give notice, nor do the friends of the parties. The practice is to bury them a day or two after their decease."

Mr. James Hunter of the Alloa colliery, said:—"That four accidents of a fatal nature have taken place at this colliery, and that when such occur, the Sheriff sometimes comes down. He did in the last case, after the death of John Patteson, which was occasioned by being over-wound at the pit-head. After looking at the ropes and examining their strength, he walked away and no further notice was taken. This is the common practice." Dr. Allison remarks:—"I am pretty sure about fifty people under my care, and connected with collieries, have lost their lives in consequence of accidents occurring in the works round Tranent, and I do not remember of an investigation having been made by the Sheriff in more than one instance."

So that in Scotland, it appears, even the semblance of an inquiry is rarely instituted; a state of things which shews such an indifference to the sacrifice of human life, as cannot be considered otherwise than derogatory to the country.

A similar absence of inquiry occurs in other parts of the kingdom, in cases of inundations such as happened at Workington and Landshipping, by which eighty lives were lost, and in consequence of the bodies of the sufferers not being recovered, no inquest could be held. Although the law is stated to be:—"That where the body cannot be found, or is so putrified that a view would be of no service, the Coroner, without a special commission, cannot take the inquest; but in such cases it shall be taken by justices of the peace, or other justices authorised by the testimony of witnesses." * Yet in neither of these cases was any inquiry instituted. In any new laws that may be made, therefore, these cases ought not to be lost sight of, and provisions ought to be made for a searching inquiry into the cause of every accident producing violent deaths in our mines.

Another objection, which is very generally entertained by the coal owners is, that were the adoption of the requisite measures to provide safety for their workmen made compulsory, and their works submitted to the periodical inspection of a Government Official, their interests would be materially injured. I think this objection is untenable. It has already been stated, that the pecuniary interests of the owners would be promoted and not prejudiced by the adoption of these measures. In ill-ventilated, imperfectly designed, and badly managed collieries, some immediate, although temporary inconvenience may arise in consequence of the necessary expense to be incurred by making the requisite improvements, but surely this consideration is insufficient to justify their remaining as they now are, especially when it is borne in mind that these improve-

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* Sewell's Law of Coroner, 1843, p. 156.

ments will, ultimately, be remunerative. It may doubtless happen that the collieries of some few owners of limited capital may be closed in consequence, but it ought to be considered that parties who embark in a speculation without the means of carrying it on with safety to those whom they employ, are not entitled to an exemption involving such serious results to their workmen. By referring to the reports and evidence of the Commissioners, it will be seen that the collieries belonging to persons of limited means, are almost invariably the most dangerous and worst conducted in the district; whilst those which belong to parties possessing ample pecuniary resources, are the best managed, and have the fewest accidents. It will be generally admitted by all conversant with colliery affairs, that whilst the small owner is constantly struggling with difficulties, owing to the want of sufficient capital, it is but very rarely he betters his condition by perseverance; the evil therefore, if it be any, that may possibly be inflicted on this class, is by no means so important as to counterbalance the much greater evils that would accrue from the non-interference of the legislature.

The objections to an official inspection are very natural. No one likes the intrusion of a Government Officer into their private concerns. But in this, as in other instances, in which a great good is sought to be obtained; private feeling, and all little jealousies ought to give place to the urgent necessity there is for such measures as have been proposed.

In conclusion, it may be observed, that the object sought to be obtained involves no new principle, but merely seeks for an extension of one long recognised and acted upon. Our factories, commerce, railways and shipping have all been subjected to legislative interference. In almost every Session of Parliament some new law is proposed, which materially affects the relations that exist between the employer and the employed in some branch of British industry; most, if not all, of these laws have been productive of benefits to the labouring population.

In 1842 an Act of Parliament was passed which prohibited the employment of females and boys under ten years of age in collieries: although it has withdrawn many persons from an occupation to which they were accustomed, but which was in every way unsuitable for them, yet its provisions affected only an inconsiderable portion of the whole number of persons who are employed in the mines, and left unredressed and unalleviated the many evils which the majority have still to endure. Notwithstanding the opposition this Act encountered in its progress through Parliament, it is now generally, if not universally, admitted that its operation, wherever it has been enforced, has been attended with the most beneficial results.

It is for a participation in the great advantages which ensue from such enactments, that we urge the claims of the miners; who, although more exposed to danger and misery than any other class of Her Majesty's subjects, have received less attention from the legislature to their peculiar wants and urgent necessities than others who are engaged in less hazardous occupations.

Although a suffering, they are an uncomplaining race. Secluded from the world's observation, they quietly and industriously pursue that labour which is indispensable to our national existence, amid darkness and many dangers; and if the value of the labour performed under such circumstances constitutes a strong claim, as it undoubtedly does, to every possible legislative protection, there are none more eminently entitled to it than the British Miner.

REFERENCE TO THE PLANS.

The plans are explanatory of the modes of working and ventilating collieries in the Northumberland and South Wales districts.

PLATE I.

The first plan shews the system pursued in the collieries of Newcastle-upon-Tyne (or Durham and Northumberland.)

A, A, is the inlet air-drift, communicating with the down-cast shaft.

B, B, is the return air-drift which is continued to the furnace and to the up-cast shaft.

C, C, is the whole coal, into which the headings at M, M, M, M, are being driven.

D, D, is the broken coal and the goaf, from which the coal has been extracted, and the roof allowed to fall.

F, F, F, F, are the stoppings by which the air is confined to its course; they are either walls built of bricks laid in mortar or trap doors. Of these doors there are generally two, placed at a short distance from each other, one of which only is opened at a time, to permit the passage of the trams. They are opened and closed by boys called "Trappers."

G, G, G, G, are the headways which are driven from 8 to 12 feet wide, for the purpose of obtaining the coal.

H, H, H, H, are holes or "bordes" driven at right angles to the headways every 20 yards.

K, K, are crossings, or tunnels passing over (or under) the air-drift A, and communicating with the return air-drift B.

L, L, are partial stoppings, to regulate the quantity of air to be admitted into any portion of the works.

M, M, M, M, are the places of work, up the centre of which a wooden partition or "stentings" is fixed to guide the air to the face of the coal.

N, N, is pillar work; when the pillars are removed in this way it is called a "jud," but when the roof has fallen into the headways at the sides of the pillar, they are worked from one end as shewn at O, and are called "jenkins."

In this plan the air is shewn as divided into three columns; the course of the first column is shewn by the dotted arrows, and ventilates the works in the whole coal, and after "coursing" up and down the headways, makes its exit through the first crossing into the return air-drift, and is drawn thence over the furnace to the up-cast shaft. The second column of air, denoted by plain arrows, passes under the first crossing, and ascends the headway leading to the goaf, round which it continues to the farthest headway, down which it passes into the return air-drift, carrying off and preventing any accumulation of fire-damp in the goaf. The third column is shewn by the feathered arrow, and in its course ventilates the pillar-works and enters the return drift through the second crossing, and there unites with the other two columns and passes to and over the furnace, and then ascends the up-cast shaft. In cases where large quantities of fire-damp are given out at the juds, or in the goaf, the return air from them is directed into a separate drift and passed into the up-cast-shaft at a considerable height above the furnace, without being allowed to come into contact with it;—this is called a "dumb-furnace."

This plan shews the general principle of ventilation and working of the collieries in the North of England, as well as in some other districts; which is however variously modified to suit the peculiar circumstances of each mine.

PLATE II.

The second plate is a plan of the actual workings of a colliery in South Wales. In design and execution, it is not only inferior to the Newcastle plan, but to many in the Principality also. The waste of coal consequent upon this system of working is manifest; and although a furnace is employed for the purposes of ventilation, the means used to direct the air through the workings are imperfect and inefficient. In this mine, from 100 to 200 men and 10 or 15 horses were at times employed; there was no fire-damp in the colliery, but the "after" or "black-damp" (carbonic-acid gas) was at times so prevalent as to compel the men to leave their work in consequence of the candles being extinguished, or burning so feebly and dimly as not to afford sufficient light for them to pursue their labours.

A, is the adit or level heading which is entered at the side of a hill, and in ventilation answers the same purpose as a down-cast shaft. It is 6 feet wide and 5½ feet high.

B. is the furnace communicating with the return-air drift. This drift is 4 feet square, *i. e.* only half the area of the inlet air-drift.

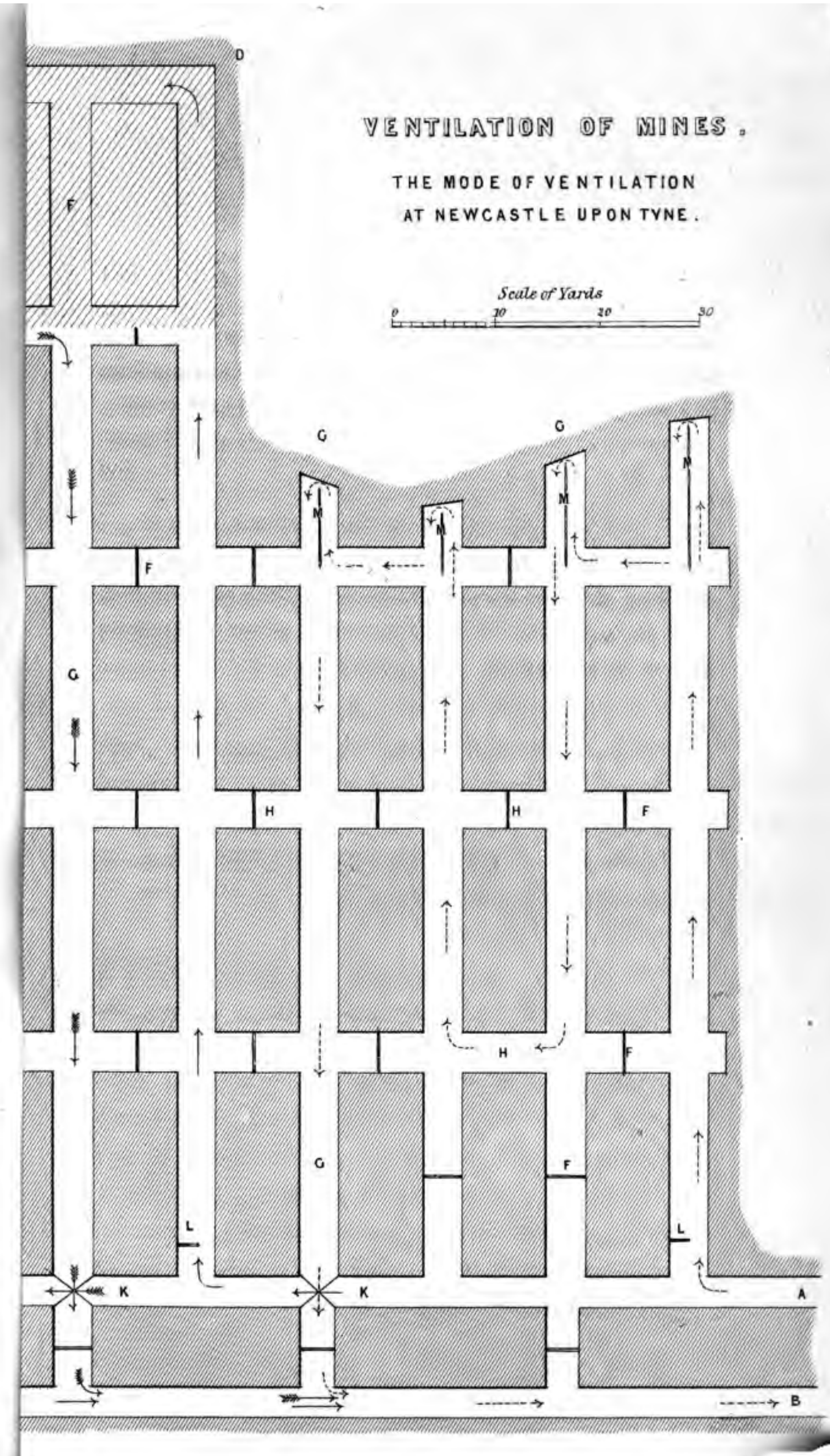
There are three (out of four) cross-headings shewn, which are driven at nearly right angles with the level heading and in the direction of the rise of the coal. From each side of the cross-headings the stalls are driven for the purpose of obtaining the coal and are marked D, D, D, D, on the plan.

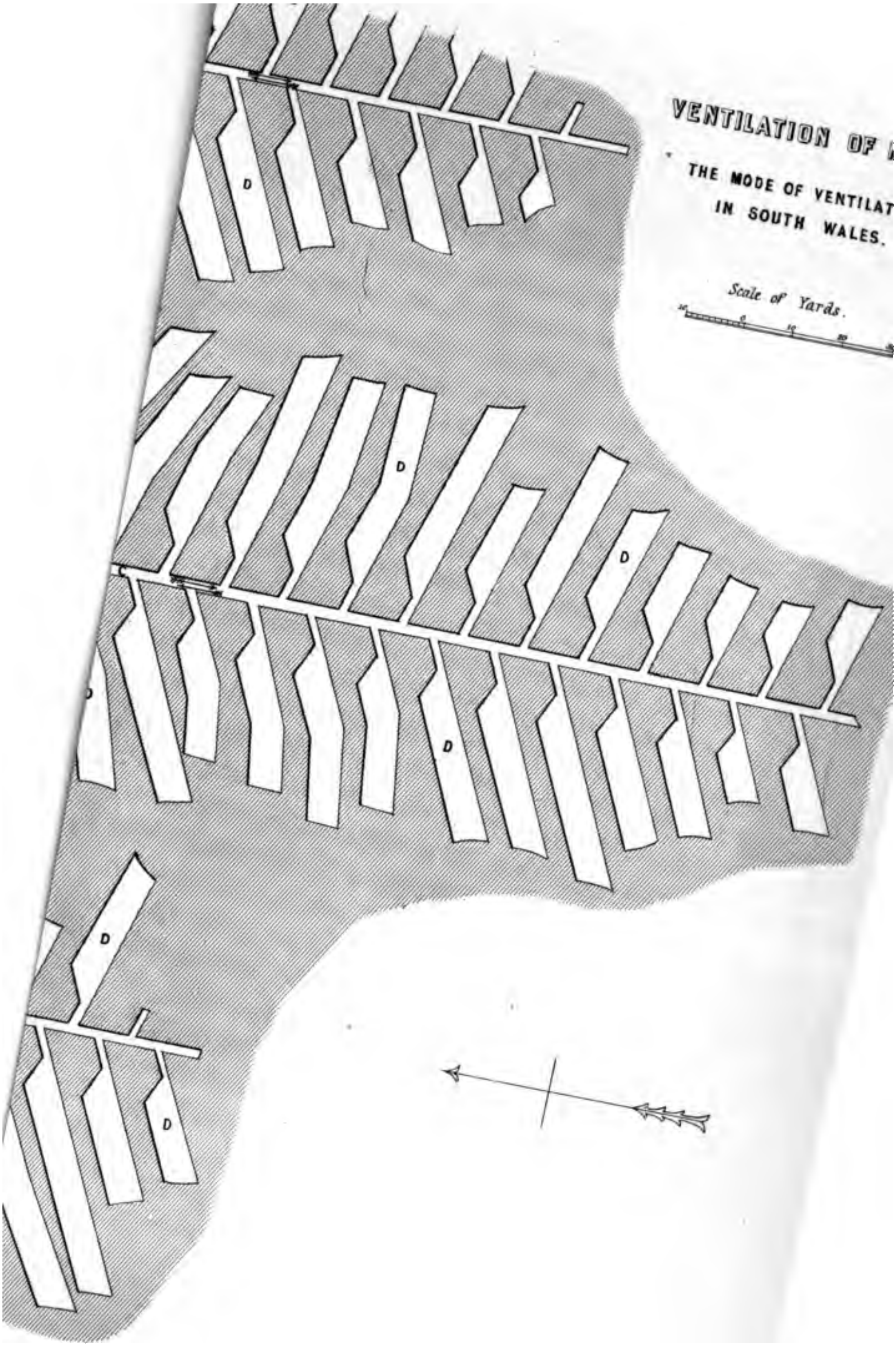
The air enters the mine in the level-heading, at *A*, and proceeds to the end of it, near which it passes through a cross wind-way (4 feet square) into the return wind-way, ventilating in its progress, but very imperfectly, the cross-headings and stalls, and taking its exit from the mine over the furnace, and up the chimney at B. With the exception of the stoppings in the old cross-wind-ways (which are made of rubbish) and a single trap door at the entrance of the cross-headings, no means are taken to direct the air into the workings, or is any attempt made to divide the fresh air into several separate columns, so that each place of work might be supplied with good air, unloaded and uncontaminated by the impurities it gathers in its progress.

T. Maber, Printer, Church-street, Neath.

VENTILATION OF MINES.

THE MODE OF VENTILATION
AT NEWCASTLE UPON TYNE.





VENTILATION OF

THE MODE OF VENTILAT
IN SOUTH WALES.

Day & Son, Lithrs. to the Queen

BOUND
BY T. MABER,
NEATH.